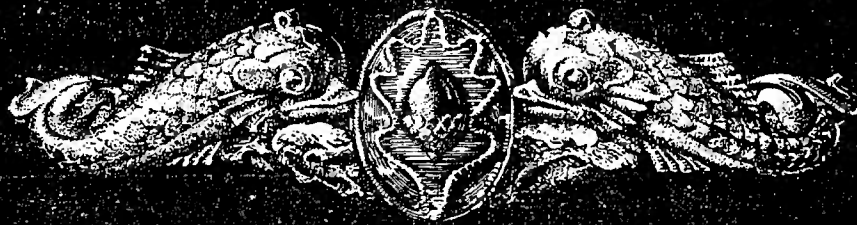# MEDICAL RESEARCH LABORATORY

U. S. Naval Submarine Base
New London

COMPARISON OF RESULTS OBTAINED ON THE EXPERIMENTAL FORM OF
THE OFFICER MECHANICAL APTITUDE TEST, FORM X-1 (NAVPERS-
16640) WITH (1) RESULTS ON THE OFFICER QUALIFICATION TEST,
FORM 3, (NAVPERS-16563) AND (2) GRADES IN SUBMARINE SCHOOL

Project No. X-382 (Sub. No. 71)

This report was prepared by

Ens. N. R. Bartlett H-V(S) U. S. N. R.

DOWNGRADED TO
UNCLASSIFIED

Captain C. W. Shilling (MC) U. S. N.
Medical Officer in Charge
Medical Research Laboratory
U. S. Submarine Base
New London, Conn.

August 9, 1944

COMPARISON OF RESULTS OBTAINED ON THE EXPERIMENTAL
FORM OF THE OFFICER MECHANICAL APTITUDE TEST,
FORM X-1 (NAVPERS-16640) WITH (1) RESULTS ON THE
OFFICER QUALIFICATION TEST, FORM 3, (NAVPERS-
16563) AND (2) GRADES IN SUBMARINE SCHOOL.

Summary:

    Means and standard deviations of test scores are reported for a
population of commissioned candidates for submarine school. Correla-
tion coefficients showing the relationship of the scores to each other
and to submarine school grades are presented. It is noted that of the
various sections of these tests, those on arithmetic reasoning and
mechanical comprehension yield the largest coefficients.

    At the present time the officers' course in the submarine school
involves 12 weeks of study in the principles and operation of subma-
rines. All candidates for the school are volunteers, and are assigned
to New London only after approval of their qualifications. Indeed,
those who are assigned from Midshipmen schools have been carefully
screened by a board of submarine officers prior to assignment. Thus
the population on which this report is based is a somewhat selected
sample of junior commissioned officers.

    The study was undertaken in order to determine the interrelation-
ship of certain selection devices and the success of those devices in
predicting grades in submarine school. The choice of tests was govern-
ed by previous decisions on the proposed content of the Officer Classi-
fication Test; both scales discussed in this paper are incorporated in
modified form in this new instrument.

    OSRD Report No. 3168 indicates that one of the three sections of
the Officer Qualification Test bears a low relationship to grades in
indoctrination school. The weak section was that dealing with mechanical
comprehension. Preliminary research at this activity, however, made it
appear that the least valid of the three in terms of submarine school
grades was the vocabulary section. This study will furnish further data
on the question.

Procedure:

    Both tests were applied as a part of the admission procedure for
candidates for submarine school. On the printed schedule for each

officer, one event was listed as "Aptitude Tests." Thus, although the tests were actually experimental, the candidates regarded them as one of the several hurdles which were to be satisfied along with the medical examinations, training in the use of the escape appliance, swimming tests, etc. Since each officer was a volunteer for submarine duty, conditions were ideal from the standpoint of test motivation. Physical conditions for conducting examinations were also satisfactory. Altogether, four groups comprising a total of 284 officers were examined.

The order of administration was not varied. The Officer Qualification Test was first on the schedule, then a ten-minute rest was interpolated before administration of the Mechanical Aptitude Test. There were no pauses between sections of the latter beyond the time necessary for the examiner to read the instructions aloud.

Only three sections of the Mechanical Aptitude Test were used; Section A, dealing with assembly of plane surface figures, was omitted in accordance with suggestions from the Test Research Unit of the Bureau of Personnel. The time limits for the different sections are as follows:

Block Assembly	15 minutes
Rotation of Solid Figures	20 minutes
Mechanical Comprehension	25 minutes

Some of the candidates failed to qualify for submarine school, and others later failed the school because of low aptitude ratings. Neither of these two groups is treated in this study, however. In the first place, the failures are primarily a matter of evaluations of personal aptitude rather than of academic grades. And second, test scores were known to medical officers who figure to some extent in disqualifications. Accordingly, it was decided to deal only with grades for officers who completed the course.

Results:

Each test was scored by counting the number of questions answered correctly. The correlation between total score for the three sections of the OMAT and total raw score for the OQT is based on the entire number tested, or 284. The product moment coefficient is 0.46. Means and standard deviations for total scores and part scores for each test are indicated in Table I, below.

TABLE I

Means and Standard Deviations

	284 Candidates		258 Graduates	
	MEAN	S.D.	MEAN	S.D.
OQT Total	65.37	13.77	66.33	13.72
" Vocabulary	27.30	8.40	27.34	8.41
" Mech. Comprehension	21.75	4.19	22.00	4.16
" Arith. Reasoning	14.89	3.12	15.12	3.08
OMAT Total	73.95	14.26	74.30	14.21
" Block Counting	21.75	4.30	21.80	4.28
" Block Rotation	20.04	5.36	20.13	5.33
" Mech. Comprehension	33.14	7.92	33.40	7.82

Final grades in the submarine school are a weighted combination of several marks. Each examination grade is multiplied by a given coefficient; and the final grade is a fraction of the sum of the products. The coefficients in effect at this time are shown in Table II. It should be emphasized that the coefficients do not of themselves determine the weight of a given examination, because the variabilities for the examination grades differ. For example, the mean of the ranges for the three aptitude grades is approximately one-half the mean of the ranges for all other grades. The distributions and the intercorrelations of the grades are not discussed in this report, nor are correlations of tests with individual subjects treated. For the purposes of this study, the final multiple grade is assumed as the criterion.

TABLE II

Coefficients for Officers' Course

Submarine Examination, First	20
Electrical Examination, First	20
Engineering Examination, First	20
Torpedo Examination, First	20
Communication Examination, First	20
Aptitude, 4th Week	10
General Examination, average	15
Aptitude, 8th Week	20
Attack Teacher, 8th Week	20
Submarine Training Device, 8th week	15

```
Underway Approach                                    20
Torpedo Preparation and Reports                       5
Attack Teacher, 12th Week                            15
Aptitude, 12th Week                                  20
Submarine Training Device, 12th Week                 10
Communication Examination, 12th Week                 15
Submarine Examination, 12th Week                     15
Electrical Examination, 12th Week                    15
Engineering Examination, 12th Week                   15
Torpedo Examination, 12th Week                       15
```

                              Total Co-efficient   325

Correlation coefficients with the final multiple grades are indicated in Table III below. Some data are also presented for 238 graduates of the previous class.

TABLE III

Product-moment correlation coefficients of
scores with Submarine School grades.

Test Score	Jan-April Class	April-June Class
OQT Total	0.38	0.46
" Vocabulary	0.23	0.24
" Mech. Comprehension	0.35	0.35
" Arith. Reasoning	0.38	0.47
" Arith. Reasoning plus Mech. Comprehension	0.40	0.47
QMAT Total		0.36
" Block Counting		0.28
" Block Rotation		0.25
" Mech. Comprehension		0.34

Discussion:

Inspection of Table III shows that those sections involving arithmetic reasoning and mechanical comprehension are the most closely related to grades in submarine school. Indeed, the score on the arithmetic reasoning section alone appears to be as good an indicator of subsequent grades as the total OQT score, and the mechanical comprehension score of the QMAT is almost as efficient as the total QMAT score.

It is noted that a combination of the total scores for the OMAT and OQT tests does not increase the accuracy of the forecasting that can be made from the OQT alone. Of the combinations investigated, the sum of scores for the arithmetic reasoning and mechanical comprehension sections appears to be the most promising. However, no methods of combinations other than simple additions of raw scores have been explored. It has been suggested by various interviewing officers that some profile or grid scoring technique might yield better prediction than total scores. It is probable that such techniques involve low reliabilities, but at any rate these suggestions might be pursued in studies of the Officer Classification Test.

Analysis of the grades at the Submarine School is indicated before any elaborate studies of test validation may be executed. Arrangements for such research are underway, and should permit a detailed study of the Officer Classification Test in the near future. However, even without statistical analysis, one general characteristic of the final grade may be perceived by reference to Table II. This table points to a predominance of technical engineering material in the course.

Finally, it should be emphasized that no data were immediately available from previous administrations of officer selection instruments. A few individuals involved in this study volunteered the information that they had been examined twice with other forms of the Officer Qualification Test. There are no means of evaluating the influence of antecedent tests on the scores reported herein. At any rate, there would have been a saving in testing time and possibly some change in score distributions and validity coefficients if records for previous examinations had been maintained in such form that they were accessible.